

## Sequence Listing

## SEQUENCE LISTING

5 <110> Suzanne L. Bolten  
 Alan M. Easton  
 Leslie C. Engel  
 Dean M. Messing  
 John S. Ng

10 Beverly A. Reitz  
 Scott A. Vaccaro  
 Mark C. Walker  
 Ping T. Wang  
 Robin A. Weinberg

15 <120> Aspergillus ochraceus 11 alpha  
 hydroxylase and oxidoreductase

20 <130> S03196-00-US

<140> US 09/xxx,xxx  
 <141> 2001-10-26

25 <150> USSN 60/244,300  
 <151> 2000-10-30

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 agccacaagc tgacagctca ttatc atg ccc ttc ttc act ggg ctt ctg gcg 172  
 Met Pro Phe Phe Thr Gly Leu Leu Ala  
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 Ile Tyr His Ser Leu Ile Leu Asp Asn Pro Val Gln Thr Leu Ser Thr  
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15	ggg agg gaa ttg cac ggg cac gag ccg tac aga ctc atg tct gaa tgg	412
	Gly Arg Glu Leu His Gly His Glu Pro Tyr Arg Leu Met Ser Glu Trp	
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	Gly Ser Leu Ile Val Leu Pro Pro Glu Cys Ala Asp Glu Leu Arg Asn	
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25	gac cca aga atg gac ttt gag acg ccc acc acc gac gac tcc cac gga	508
	Asp Pro Arg Met Asp Phe Glu Thr Pro Thr Thr Asp Asp Ser His Gly	
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30	tat atc cct ggc ttc gac gct ctc aac gca gac ccg aac ctg act aaa	556
	Tyr Ile Pro Gly Phe Asp Ala Leu Asn Ala Asp Pro Asn Leu Thr Lys	
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35	gtg gtc acc aag tac ctc aca aaa gca ttg aac aag ctt act gct ccg	604
	Val Val Thr Lys Tyr Leu Thr Lys Ala Leu Asn Lys Leu Thr Ala Pro	
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45	cca gat tgg cgt gag atc tac cca gcc aga gac ttg ctc cag ctc gtc	700
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50	gcc cgg atg tcg aca aga gtg ttc ctt ggc gag gaa atg tgc aat aac	748
	Ala Arg Met Ser Thr Arg Val Phe Leu Gly Glu Glu Met Cys Asn Asn	
	190 195 200	
55	cag gat tgg atc caa acc tca tca caa tac gcg gcc ctt gcc ttc ggt	796
	Gln Asp Trp Ile Gln Thr Ser Ser Gln Tyr Ala Ala Leu Ala Phe Gly	
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60	gtc ggt gac aag ctt aga ata tac ccg aga atg atc aga ccg ata gta	844
	Val Gly Asp Lys Leu Arg Ile Tyr Pro Arg Met Ile Arg Pro Ile Val	
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	His Trp Phe Met Pro Ser Cys Trp Glu Leu Arg Arg Ser Leu Arg Arg	
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	Cys Arg Gln Ile Leu Thr Pro Tyr Ile His Lys Arg Lys Ser Leu Lys	
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15	ttg cag gcc atg agc gat ctc gcg cag aac ccg aaa gtg cta caa gca Leu Gln Ala Met Ser Asp Leu Ala Gln Asn Pro Lys Val Leu Gln Ala 315 320 325	1132
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35	gtc gtg atc gac agc acc cat atg tgg aat ccc gag tat tac act gac Val Val Ile Asp Ser Thr His Met Trp Asn Pro Glu Tyr Tyr Thr Asp 395 400 405	1372
40	cct ctc cag tac gac ggg tac cgc tac ttc aac aag cgg cag aca ccc Pro Leu Gln Tyr Asp Gly Tyr Arg Tyr Phe Asn Lys Arg Gln Thr Pro 410 415 420 425	1420
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50	aac gag atc aag att gcc ttg tgt cat atc atc tta aat tat gag tgg Asn Glu Ile Lys Ile Ala Leu Cys His Ile Ile Leu Asn Tyr Glu Trp 460 465 470	1564
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 25 Glu Asn Ser Lys Ser Leu Ala Arg Gly Arg Glu Leu His Gly His  
 65 70 75 80  
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 Pro Glu Cys Ala Asp Glu Leu Arg Asn Asp Pro Arg Met Asp Phe Glu  
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 30 Thr Pro Thr Thr Asp Asp Ser His Gly Tyr Ile Pro Gly Phe Asp Ala  
 115 120 125  
 Leu Asn Ala Asp Pro Asn Leu Thr Lys Val Val Thr Lys Tyr Leu Thr  
 130 135 140  
 35 Lys Ala Leu Asn Lys Leu Thr Ala Pro Ile Ser His Glu Ala Ser Ile  
 145 150 155 160  
 Ala Met Lys Ala Val Leu Gly Asp Asp Pro Asp Trp Arg Glu Ile Tyr  
 165 170 175  
 Pro Ala Arg Asp Leu Leu Gln Leu Val Ala Arg Met Ser Thr Arg Val  
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 40 Phe Leu Gly Glu Glu Met Cys Asn Asn Gln Asp Trp Ile Gln Thr Ser  
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 Ser Gln Tyr Ala Ala Leu Ala Phe Gly Val Gly Asp Lys Leu Arg Ile  
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 45 Tyr Pro Arg Met Ile Arg Pro Ile Val His Trp Phe Met Pro Ser Cys  
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 Trp Glu Leu Arg Arg Ser Leu Arg Arg Cys Arg Gln Ile Leu Thr Pro  
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 Tyr Ile His Lys Arg Lys Ser Leu Lys Gly Thr Thr Asp Glu Gln Gly  
 260 265 270  
 50 Lys Pro Leu Met Phe Asp Asp Ser Ile Glu Trp Phe Glu Arg Glu Leu  
 275 280 285  
 Gly Pro Asn His Asp Ala Val Leu Lys Gln Val Thr Leu Ser Ile Val  
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 55 Ala Ile His Thr Thr Ser Asp Leu Leu Leu Gln Ala Met Ser Asp Leu  
 305 310 315 320  
 Ala Gln Asn Pro Lys Val Leu Gln Ala Val Arg Glu Glu Val Val Arg

325 330 335  
 Val Leu Ser Thr Glu Gly Leu Ser Lys Val Ser Leu His Ser Leu Lys  
 340 345 350  
 Leu Met Asp Ser Ala Leu Lys Glu Ser Gln Arg Leu Arg Pro Thr Leu  
 5 355 360 365  
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 370 375 380  
 Gly Phe Val Ile Lys Lys Gly Thr Arg Val Val Ile Asp Ser Thr His  
 385 390 395 400  
 10 Met Trp Asn Pro Glu Tyr Tyr Thr Asp Pro Leu Gln Tyr Asp Gly Tyr  
 405 410 415  
 Arg Tyr Phe Asn Lys Arg Gln Thr Pro Gly Glu Asp Lys Asn Ala Leu  
 420 425 430  
 Leu Val Ser Thr Ser Ala Asn His Met Gly Phe Gly His Gly Val His  
 15 435 440 445  
 Ala Cys Pro Gly Arg Phe Phe Ala Ser Asn Glu Ile Lys Ile Ala Leu  
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 Cys His Ile Ile Leu Asn Tyr Glu Trp Arg Leu Pro Asp Gly Phe Lys  
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 gcc gaa gaa gta tct ctt ttc agc atg acg gac atg att ctg ttt tcg 96  
 Ala Glu Glu Val Ser Leu Phe Ser Met Thr Asp Met Ile Leu Phe Ser  
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 45 ctc atc gtg ggt ctc cta acc tac tgg ttc ctc ttc aga aag aaa aaa 144  
 Leu Ile Val Gly Leu Leu Thr Tyr Trp Phe Leu Phe Arg Lys Lys Lys  
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 Glu Glu Val Pro Glu Phe Thr Lys Ile Gln Thr Leu Thr Ser Ser Val  
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 aga gag agc agc ttt gtg gaa aag atg aag aaa acg ggg agg aac atc 240  
 55 Arg Glu Ser Ser Phe Val Glu Lys Met Lys Lys Thr Gly Arg Asn Ile  
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**THE**

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 305 310 315 320

5 gct gtg tac cca gcc aac gac tct gct ctc gtc aac cag ctg ggc aaa 1008  
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 325 330 335

10 atc ctg ggt gcc gac ctg gac gtc gtc atg tcc ctg aac aac ctg gat 1056  
 Ile Leu Gly Ala Asp Leu Asp Val Val Met Ser Leu Asn Asn Leu Asp  
 340 345 350

15 gag gag tcc aac aag aag cac cca ttc ccg tgc cct acg tcc tac cgc 1104  
 Glu Glu Ser Asn Lys Lys His Pro Phe Pro Cys Pro Thr Ser Tyr Arg  
 355 360 365

acg gcc ctc acc tac tac ctg gac atc acc aac ccg ccg cgt acc aac 1152  
 Thr Ala Leu Thr Tyr Tyr Leu Asp Ile Thr Asn Pro Pro Arg Thr Asn  
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20 gtg ctg tac gag ctg gcg cag tac gcc tcg gag ccc tcg gag cag gag 1200  
 Val Leu Tyr Glu Leu Ala Gln Tyr Ala Ser Glu Pro Ser Glu Gln Glu  
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25 ctg ctg cgc aag atg gcc tcc tcc tcc ggc gag ggc aag gag ctg tac 1248  
 Leu Leu Arg Lys Met Ala Ser Ser Ser Gly Glu Gly Lys Glu Leu Tyr  
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30 ctg agc tgg gtg gtg gag gcc ccg agg cac atc ctg gcc atc ctg cag 1296  
 Leu Ser Trp Val Val Glu Ala Arg Arg His Ile Leu Ala Ile Leu Gln  
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35 gac tgc ccg tcc ctg ccg ccc ccc atc gac cac ctg tgt gag ctg ctg 1344  
 Asp Cys Pro Ser Leu Arg Pro Pro Ile Asp His Leu Cys Glu Leu Leu  
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ccg cgc ctg cag gcc cgc tac tac tcc atc gcc tca tcc tcc aag gtc 1392  
 Pro Arg Leu Gln Ala Arg Tyr Tyr Ser Ile Ala Ser Ser Ser Lys Val  
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40 cac ccc aac tct gtg cac atc tgt gcg gtg gtt gtg gag tac gag acc 1440  
 His Pro Asn Ser Val His Ile Cys Ala Val Val Glu Tyr Glu Thr  
 465 470 475 480

45 aag gcc ggc cgc atc aac aag ggc gtg gcc acc aac tgg ctg ccg gcc 1488  
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 Lys Glu Pro Ala Gly Glu Asn Gly Gly Arg Ala Leu Val Pro Met Phe  
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55 gtg cgc aag tcc cag ttc cgc ctg ccc ttc aag gcc acc acg cct gtc 1584  
 Val Arg Lys Ser Gln Phe Arg Leu Pro Phe Lys Ala Thr Thr Pro Val  
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	ctg ctg tac tac ggc tgc cgc cgc tcg gat gag gac tac ctg tac cgg			1728
	Leu Leu Tyr Tyr Gly Cys Arg Arg Ser Asp Glu Asp Tyr Leu Tyr Arg			
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	gag gag ctg gcg cag ttc cac agg gac ggt gcg ctc acc cag ctc aac			1776
	Glu Glu Leu Ala Gln Phe His Arg Asp Gly Ala Leu Thr Gln Leu Asn			
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	gtg gcc ttc tcc cgg gag cag tcc cac aag gtc tac gtc cag cac ctg			1824
	Val Ala Phe Ser Arg Glu Gln Ser His Lys Val Tyr Val Gln His Leu			
	595	600	605	
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	cta aag caa gac cga gag cac ctg tgg aag ttg atc gaa ggc ggt gcc			1872
	Leu Lys Gln Asp Arg Glu His Leu Trp Lys Leu Ile Glu Gly Gly Ala			
	610	615	620	
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	cac atc tac gtc tgt ggg gat gca cgg aac atg gcc agg gat gtg cag			1920
	His Ile Tyr Val Cys Gly Asp Ala Arg Asn Met Ala Arg Asp Val Gln			
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	Asn Thr Phe Tyr Asp Ile Val Ala Glu Leu Gly Ala Met Glu His Ala			
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	85	90	95	



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 Asp Pro Glu Glu Tyr Asp Leu Ala Asp Leu Ser Ser Leu Pro Glu Ile  
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 15 Asp Gly Asn Leu Glu Glu Asp Phe Ile Thr Trp Arg Glu Gln Phe Trp  
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 Pro Ala Val Cys Glu His Phe Gly Val Glu Ala Thr Gly Glu Glu Ser  
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 Ser Ile Arg Gln Tyr Glu Leu Val Val His Thr Asp Ile Asp Ala Ala  
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 Glu Glu Ser Asn Lys Lys His Pro Phe Pro Cys Pro Thr Ser Tyr Arg  
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 Val Arg Lys Ser Gln Phe Arg Leu Pro Phe Lys Ala Thr Thr Pro Val  
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	atcgaattcg	caattccttc	ctcgtgactc	ttcatcgctg	agcgtcctca	tc atg gcg										238
						Met Ala										
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	caa ctc gat	act ctc gat	ttg gtc gtc	ctg gtg gcg	ctc ttg gtg ggt											286
	Gln Leu Asp	Thr Leu Asp	Leu Val Leu	Val Ala Leu	Leu Val Gly											
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	Ser Val Ala	Tyr Phe Thr	Lys Gly Thr	Tyr Trp Ala	Val Ala Lys	Asp										
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	Pro Tyr Ala	Ser Ala Gly	Pro Ala Met	Asn Gly Gly	Ala Lys Ala	Gly										
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	Ala Asp Leu Glu Asp Tyr Asp Tyr Glu Asn Leu Glu Lys Phe Pro Glu																
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	Asp Lys Val Val Phe Phe Val Leu Ala Thr Tyr Gly Glu Gly Glu Pro																
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	Thr Asp Asn Ala Val Glu Phe Tyr Gln Phe Val Thr Gly Glu Asp Ala																
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	Ala Phe Glu Ser Gly Ala Thr Ala Asp Asp Lys Pro Leu Ser Ser Leu																
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25	aag tat gtc acg ttt ggt ctg ggt aac aac acc tat gag cac tac aac																766
	Lys Tyr Val Thr Phe Gly Leu Gly Asn Asn Thr Tyr Glu His Tyr Asn																
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 Glu Thr Met Arg Leu His Pro Pro Val Pro Leu Leu Val Pro Arg Val  
                             370                            375                            380  
 40 Ser Arg Glu Arg Cys Gln Ile Asn Gly Tyr Glu Ile Pro Ser Lys Thr  
                             385                            390                            395                            400  
 Arg Ile Ile Ile Asn Ala Trp Ala Ile Gly Arg Asn Pro Lys Tyr Trp  
                             405                            410                            415  
 Gly Glu Thr Glu Ser Phe Lys Pro Glu Arg Phe Leu Asn Ser Ser Ile  
                             420                            425                            430  
 45 Asp Phe Arg Gly Thr Asp Phe Glu Phe Ile Pro Phe Gly Ala Gly Arg  
                             435                            440                            445  
 Arg Ile Cys Pro Gly Ile Thr Phe Ala Ile Pro Asn Ile Glu Leu Pro  
                             450                            455                            460  
 50 Leu Ala Gln Leu Leu Tyr His Phe Asp Trp Lys Leu Pro Asn Lys Met  
                             465                            470                            475                            480  
 Lys Asn Glu Glu Leu Asp Met Thr Glu Ser Asn Gly Ile Thr Leu Arg  
                             485                            490                            495  
 Arg Gln Asn Asp Leu Cys Leu Ile Pro Ile Thr Arg Leu Pro  
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&lt;211&gt; 524

&lt;212&gt; PRT

&lt;213&gt; Gibberella fujikuroi CAA75566

&lt;400&gt; 31

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 Pro Phe Tyr Ile Ala Ile Phe Val Phe Thr Leu Val Pro Trp Ala Ile  
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 Arg Phe Ser Trp Leu Glu Leu Arg Lys Gly Ser Val Val Pro Leu Ala  
 35 40 45  
 10 Asn Pro Pro Asp Ser Leu Phe Gly Thr Gly Lys Thr Arg Arg Ser Phe  
 50 55 60  
 Val Lys Leu Ser Arg Glu Ile Leu Ala Lys Ala Arg Ser Leu Phe Pro  
 65 70 75 80  
 15 Asn Glu Pro Phe Arg Leu Ile Thr Asp Trp Gly Glu Val Leu Ile Leu  
 85 90 95  
 Pro Pro Asp Phe Ala Asp Glu Ile Arg Asn Asp Pro Arg Leu Ser Phe  
 100 105 110  
 Ser Lys Ala Ala Met Gln Asp Asn His Ala Gly Ile Pro Gly Phe Glu  
 115 120 125  
 20 Thr Val Ala Leu Val Gly Arg Glu Asp Gln Leu Ile Gln Lys Val Ala  
 130 135 140  
 Arg Lys Gln Leu Thr Lys His Leu Ser Ala Val Ile Glu Pro Leu Ser  
 145 150 155 160  
 25 Arg Glu Ser Thr Leu Ala Val Ser Leu Asn Phe Gly Glu Thr Thr Glu  
 165 170 175  
 Trp Arg Ala Ile Arg Leu Lys Pro Ala Ile Leu Asp Ile Ile Ala Arg  
 180 185 190  
 Ile Ser Ser Arg Ile Tyr Leu Gly Asp Gln Leu Cys Arg Asn Glu Ala  
 195 200 205  
 30 Trp Leu Lys Ile Thr Lys Thr Tyr Thr Thr Asn Phe Tyr Thr Ala Ser  
 210 215 220  
 Thr Asn Leu Arg Met Phe Pro Arg Ser Ile Arg Pro Leu Ala His Trp  
 225 230 235 240  
 35 Phe Leu Pro Glu Cys Arg Lys Leu Arg Gln Glu Arg Lys Asp Ala Ile  
 245 250 255  
 Gly Ile Ile Thr Pro Leu Ile Glu Arg Arg Arg Glu Leu Arg Arg Ala  
 260 265 270  
 Ala Ile Ala Ala Gly Gln Pro Leu Pro Val Phe His Asp Ala Ile Asp  
 275 280 285  
 40 Trp Ser Glu Gln Glu Ala Glu Ala Ala Gly Thr Gly Ala Ser Phe Asp  
 290 295 300  
 Pro Val Ile Phe Gln Leu Thr Leu Ser Leu Leu Ala Ile His Thr Thr  
 305 310 315 320  
 45 Tyr Asp Leu Leu Gln Thr Met Ile Asp Leu Gly Arg His Pro Glu  
 325 330 335  
 Tyr Ile Glu Pro Leu Arg Gln Glu Val Val Gln Leu Leu Arg Glu Glu  
 340 345 350  
 Gly Trp Lys Lys Thr Thr Leu Phe Lys Met Lys Leu Leu Asp Ser Ala  
 355 360 365  
 50 Ile Lys Glu Ser Gln Arg Met Lys Pro Gly Ser Ile Val Thr Met Arg  
 370 375 380  
 Arg Tyr Val Thr Glu Asp Ile Thr Leu Ser Ser Gly Leu Thr Leu Lys  
 385 390 395 400  
 55 Lys Gly Thr Arg Leu Asn Val Asp Asn Arg Arg Leu Asp Asp Pro Lys  
 405 410 415  
 Ile Tyr Asp Asn Pro Glu Val Tyr Asn Pro Tyr Arg Phe Tyr Asp Met



420 425 430  
 Arg Ser Glu Ala Gly Lys Asp His Gly Ala Gln Leu Val Ser Thr Gly  
 435 440 445  
 Ser Asn His Met Gly Phe Gly His Gly Gln His Ser Cys Pro Gly Arg  
 5 450 455 460  
 Phe Phe Ala Ala Asn Glu Ile Lys Val Ala Leu Cys His Ile Leu Val  
 465 470 475 480  
 Lys Tyr Asp Trp Lys Leu Cys Pro Asp Thr Glu Thr Lys Pro Asp Thr  
 485 490 495  
 10 Arg Gly Met Ile Ala Lys Ser Ser Pro Val Thr Asp Ile Leu Ile Lys  
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 25 Thr Ser Ala Gly Leu Leu Cys Leu Leu Tyr Leu Cys Ser Ser Gly  
 35 40 45  
 Arg Arg Ser Asp Leu Pro Val Phe Asn Pro Lys Thr Trp Trp Glu Leu  
 50 55 60  
 Thr Thr Met Arg Ala Lys Arg Asp Phe Asp Ala Asn Ala Pro Ser Trp  
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 Ile Glu Ser Trp Phe Ser Gln Asn Asp Lys Pro Ile Arg Phe Ile Val  
 85 90 95  
 Asp Ser Gly Tyr Cys Thr Ile Leu Pro Ser Ser Met Ala Asp Glu Phe  
 100 105 110  
 35 Arg Lys Met Lys Glu Leu Cys Met Tyr Lys Phe Leu Gly Thr Asp Phe  
 115 120 125  
 His Ser His Leu Pro Gly Phe Asp Gly Phe Lys Glu Val Thr Arg Asp  
 130 135 140  
 Ala His Leu Ile Thr Lys Val Val Met Asn Gln Phe Gln Thr Gln Ala  
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 Pro Lys Tyr Val Lys Pro Leu Ala Asn Glu Ala Ser Gly Ile Ile Thr  
 165 170 175  
 Asp Ile Phe Gly Asp Ser Asn Glu Trp His Thr Val Pro Val Tyr Asn  
 180 185 190  
 45 Gln Cys Leu Asp Leu Val Thr Arg Thr Val Thr Phe Ile Met Val Gly  
 195 200 205  
 Ser Lys Leu Ala His Asn Glu Glu Trp Leu Asp Ile Ala Lys His His  
 210 215 220  
 Ala Val Thr Met Ala Ile Gln Ala Arg Gln Leu Arg Leu Trp Pro Val  
 50 225 230 235 240  
 Ile Leu Arg Pro Leu Val His Trp Leu Glu Pro Gln Gly Ala Lys Leu  
 245 250 255  
 Arg Ala Gln Val Arg Arg Ala Arg Gln Leu Leu Asp Pro Ile Ile Gln  
 260 265 270  
 55 Glu Arg Arg Ala Glu Arg Asp Ala Cys Arg Ala Lys Gly Ile Glu Pro  
 275 280 285  
 Pro Arg Tyr Val Asp Ser Ile Gln Trp Phe Glu Asp Thr Ala Lys Gly

290 295 300  
 Lys Trp Tyr Asp Ala Ala Gly Ala Gln Leu Ala Met Asp Phe Ala Gly  
 305 310 315 320  
 Ile Tyr Gly Thr Ser Asp Leu Leu Ile Gly Gly Leu Val Asp Ile Val  
 5 325 330 335  
 Arg His Pro His Leu Leu Glu Pro Leu Arg Asp Glu Ile Arg Thr Val  
 340 345 350  
 Ile Gly Gln Gly Gly Trp Thr Pro Ala Ser Leu Tyr Lys Leu Lys Leu  
 355 360 365  
 10 Leu Asp Ser Cys Leu Lys Glu Ser Gln Arg Val Lys Pro Val Glu Cys  
 370 375 380  
 Ala Thr Met Arg Ser Tyr Ala Leu Gln Asp Val Thr Phe Ser Asn Gly  
 385 390 395 400  
 Thr Phe Ile Pro Lys Gly Glu Leu Val Ala Val Ala Ala Asp Arg Met  
 15 405 410 415  
 Ser Asn Pro Glu Val Trp Pro Glu Pro Ala Lys Tyr Asp Pro Tyr Arg  
 420 425 430  
 Tyr Met Arg Leu Arg Glu Asp Pro Ala Lys Ala Phe Ser Ala Gln Leu  
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 20 Glu Asn Thr Asn Gly Asp His Ile Gly Phe Gly Trp His Pro Arg Ala  
 450 455 460  
 Cys Pro Gly Arg Phe Phe Ala Ser Lys Glu Ile Lys Met Met Leu Ala  
 465 470 475 480  
 Tyr Leu Leu Ile Arg Tyr Asp Trp Lys Val Val Pro Asp Glu Pro Leu  
 25 485 490 495  
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 Ser Leu Tyr Asp Met Met Leu Arg Thr Val Ala Leu Leu Ser Gly Arg  
 35 40 45  
 Ala Phe Val Gly Leu Pro Leu Cys Arg Asp Glu Gly Trp Leu Gln Ala  
 50 55 60  
 45 Ser Ile Gly Tyr Thr Val Gln Cys Val Ser Ile Arg Asp Gln Leu Phe  
 65 70 75 80  
 Thr Trp Ser Pro Val Leu Arg Pro Ile Ile Gly Pro Phe Leu Pro Ser  
 85 90 95  
 Val Arg Ser Val Arg Arg His Leu Arg Phe Ala Ala Glu Ile Met Ala  
 100 105 110  
 50 Pro Leu Ile Ser Gln Ala Leu Gln Asp Glu Lys Gln His Arg Ala Asp  
 115 120 125  
 Thr Leu Leu Ala Asp Gln Thr Glu Gly Arg Gly Thr Phe Ile Ser Trp  
 130 135 140  
 55 Leu Leu Arg His Leu Pro Glu Glu Leu Arg Thr Pro Glu Gln Val Gly  
 145 150 155 160  
 Leu Asp Gln Met Leu Val Ser Phe Ala Ala Ile His Thr Thr Thr Met

165 170 175  
 Ala Leu Thr Lys Val Val Trp Glu Leu Val Lys Arg Pro Glu Tyr Ile  
 180 185 190  
 Glu Pro Leu Arg Thr Glu Met Gln Asp Val Phe Gly Pro Asp Ala Val  
 195 200 205  
 Ser Pro Asp Ile Cys Ile Asn Lys Glu Ala Leu Ser Arg Leu His Lys  
 210 215 220  
 Leu Asp Ser Phe Ile Arg Glu Val Gln Arg Trp Cys Pro Ser Thr Phe  
 225 230 235 240  
 Val Thr Pro Ser Arg Arg Val Met Lys Ser Met Thr Leu Ser Asn Gly  
 245 250 255  
 Ile Lys Leu Gln Arg Gly Thr Ser Ile Ala Phe Pro Ala His Ala Ile  
 260 265 270  
 His Met Ser Glu Glu Thr Pro Thr Phe Ser Pro Asp Phe Ser Ser Asp  
 275 280 285  
 Phe Glu Asn Pro Ser Pro Arg Ile Phe Asp Gly Phe Arg Tyr Leu Asn  
 290 295 300  
 Leu Arg Ser Ile Lys Gly Gln Gly Ser Gln His Gln Ala Ala Thr Thr  
 305 310 315 320  
 Gly Pro Asp Tyr Leu Ile Phe Asn His Gly Lys His Ala Cys Pro Gly  
 325 330 335  
 Arg Phe Phe Ala Ile Ser Glu Ile Lys Met Ile Leu Ile Glu Leu Leu  
 340 345 350  
 Ala Lys Tyr Asp Phe Arg Leu Glu Asp Gly Lys Pro Gly Pro Glu Leu  
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 Trp Leu Ile Tyr Val Ala Phe Gly Ala Trp Leu Cys Ser Tyr Val Ile  
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 His Val Leu Ser Ser Ser Ser Thr Val Lys Val Pro Val Val Gly Tyr  
 50 55 60  
 Arg Ser Val Phe Glu Pro Thr Trp Leu Leu Arg Leu Arg Phe Val Trp  
 65 70 75 80  
 Glu Gly Gly Ser Ile Ile Gly Gln Gly Tyr Asn Lys Phe Lys Asp Ser  
 85 90 95  
 Ile Phe Gln Val Arg Lys Leu Gly Thr Asp Ile Val Ile Ile Pro Pro  
 100 105 110  
 Asn Tyr Ile Asp Glu Val Arg Lys Leu Ser Gln Asp Lys Thr Arg Ser  
 115 120 125  
 Val Glu Pro Phe Ile Asn Asp Phe Ala Gly Gln Tyr Thr Arg Gly Met  
 130 135 140  
 Val Phe Leu Gln Ser Asp Leu Gln Asn Arg Val Ile Gln Gln Arg Leu  
 145 150 155 160  
 Thr Pro Lys Leu Val Ser Leu Thr Lys Val Met Lys Glu Glu Leu Asp

165 170 175  
 Tyr Ala Leu Thr Lys Glu Met Pro Asp Met Lys Asn Asp Glu Trp Val  
 180 185 190  
 Glu Val Asp Ile Ser Ser Ile Met Val Arg Leu Ile Ser Arg Ile Ser  
 195 200 205  
 Ala Arg Val Phe Leu Gly Pro Glu His Cys Arg Asn Gln Glu Trp Leu  
 210 215 220  
 Thr Thr Thr Ala Glu Tyr Ser Glu Ser Leu Phe Ile Thr Gly Phe Ile  
 225 230 235 240  
 10 Leu Arg Val Val Pro His Ile Leu Arg Pro Phe Ile Ala Pro Leu Leu  
 245 250 255  
 Pro Ser Tyr Arg Thr Leu Leu Arg Asn Val Ser Ser Gly Arg Arg Val  
 260 265 270  
 15 Ile Gly Asp Ile Ile Arg Ser Gln Gln Gly Asp Gly Asn Glu Asp Ile  
 275 280 285  
 Leu Ser Trp Met Arg Asp Ala Ala Thr Gly Glu Glu Lys Gln Ile Asp  
 290 295 300  
 Asn Ile Ala Gln Arg Met Leu Ile Leu Ser Leu Ala Ser Ile His Thr  
 305 310 315 320  
 20 Thr Ala Met Thr Met Thr His Ala Met Tyr Asp Leu Cys Ala Cys Pro  
 325 330 335  
 Glu Tyr Ile Glu Pro Leu Arg Asp Glu Val Lys Ser Val Val Gly Ala  
 340 345 350  
 Ser Gly Trp Asp Lys Thr Ala Leu Asn Arg Phe His Lys Leu Asp Ser  
 355 360 365  
 25 Phe Leu Lys Glu Ser Gln Arg Phe Asn Pro Val Phe Leu Leu Thr Phe  
 370 375 380  
 Asn Arg Ile Tyr His Gln Ser Met Thr Leu Ser Asp Gly Thr Asn Ile  
 385 390 395 400  
 30 Pro Ser Gly Thr Arg Ile Ala Val Pro Ser His Ala Met Leu Gln Asp  
 405 410 415  
 Ser Ala His Val Pro Gly Pro Thr Pro Pro Thr Glu Phe Asp Gly Phe  
 420 425 430  
 Arg Tyr Ser Lys Ile Arg Ser Asp Ser Asn Tyr Ala Gln Lys Tyr Leu  
 435 440 445  
 35 Phe Ser Met Thr Asp Ser Ser Asn Met Ala Phe Gly Tyr Gly Lys Tyr  
 450 455 460  
 Ala Cys Pro Gly Arg Phe Tyr Ala Ser Asn Glu Met Lys Leu Thr Leu  
 465 470 475 480  
 40 Ala Ile Leu Leu Leu Gln Phe Glu Phe Lys Leu Pro Asp Gly Lys Gly  
 485 490 495  
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 Ser Met Arg Glu Arg Gln Glu Lys Gly Gly Asn Leu Glu Asp Pro Pro

35 40 45  
 Thr Met Leu Asp His Leu Ser Asn Gly Arg Asn Glu His Ile Ala Asp  
 50 55 60  
 Asp Val Glu Leu Gln Leu Leu His Gln Met Thr Leu Ile Ala Val Gly  
 5 65 70 75 80  
 Thr Val Thr Thr Phe Ser Ser Thr Thr Gln Ala Ile Tyr Asp Leu Val  
 85 90 95  
 Ala His Pro Glu Tyr Ile Thr Ile Leu Arg Glu Glu Val Glu Ser Val  
 100 105 110  
 10 Pro Arg Asp Pro Asn Gly Asn Phe Thr Lys Asp Ser Thr Val Ala Met  
 115 120 125  
 Asp Lys Leu Asp Ser Phe Leu Lys Glu Ser Gln Arg Phe Asn Ser Pro  
 130 135 140  
 Asp Leu Ser Met Ser Asn Leu Lys Asn Tyr Lys Leu Cys Glu Ser Leu  
 15 145 150 155 160  
 Thr Gly His Ser Asn Leu Pro Thr Arg Thr Ile Ala Asp Met Lys Leu  
 165 170 175  
 Pro Asp Gly Thr Phe Val Pro Lys Gly Thr Lys Leu Glu Ile Asn Thr  
 180 185 190  
 20 Cys Ser Ile His Lys Asp His Lys Leu Tyr Glu Asn Pro Glu Gln Phe  
 195 200 205  
 Asp Gly Leu Arg Phe His Lys Trp Arg Lys Ala Pro Gly Lys Glu Lys  
 210 215 220  
 Arg Tyr Met Tyr Ser Ser Ser Gly Thr Asp Asp Leu Ser Trp Gly Phe  
 25 225 230 235 240  
 Gly Arg His Ala Cys Pro Gly Arg Tyr Leu Ser Ala Ile Asn Ile Lys  
 245 250 255  
 Leu Ile Met Ala Glu Leu Leu Met Asn Tyr Asp Ile Lys Leu Pro Asp  
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 45 Lys Ile Gly Leu Ser Gly Pro Glu Pro His Trp Phe Leu Gly Asn Leu  
 35 40 45  
 Lys Gln Thr Ala Glu Arg Lys Glu Lys Leu Gly Tyr Asp Asp Ala Asn  
 50 55 60  
 Arg Trp Phe Asn Glu Leu His Glu Gln Tyr Gly Glu Thr Phe Gly Ile  
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 Tyr Tyr Gly Ser Gln Met Asn Ile Val Ile Ser Asn Glu Lys Asp Ile  
 85 90 95  
 Lys Glu Val Phe Ile Lys Asn Phe Ser Asn Phe Ser Asp Arg Ser Val  
 100 105 110  
 55 Pro Ser Ile Tyr Glu Ala Asn Gln Leu Thr Ala Ser Leu Leu Met Asn  
 115 120 125  
 Ser Tyr Ser Ser Gly Trp Lys His Thr Arg Ser Ala Ile Ala Pro Ile

130 135 140  
 Phe Ser Thr Gly Lys Met Lys Ala Met Gln Glu Thr Ile Asn Ser Lys  
 145 150 155 160  
 Val Asp Leu Phe Leu Asp Ile Leu Arg Glu Lys Ala Ser Ser Gly Gln  
 5 165 170 175  
 Lys Trp Asp Ile Tyr Asp Asp Phe Gln Gly Leu Thr Leu Asp Val Ile  
 180 185 190  
 Gly Lys Cys Ala Phe Ala Ile Asp Ser Asn Cys Gln Arg Asp Arg Asn  
 195 200 205  
 10 Asp Val Phe Tyr His Pro Val Thr Val Lys Ile Thr Ile Asn Asn Phe  
 210 215 220  
 Thr Tyr Phe His Ser Ser Ser Pro Gly Thr Phe His Phe Leu Glu Ser  
 225 230 235 240  
 Thr Leu Gln Ile His Thr Thr Gly Arg Cys Arg Asn Ser Thr Cys Arg  
 15 245 250 255  
 Arg Thr Val Lys Cys Val Gly Phe Arg Gln Asp Lys Ala Lys Phe Cys  
 260 265 270  
 Ser Asp Tyr Glu Arg Arg Arg Gly Gly Glu Gly Ser Asp Ser Val Asp  
 275 280 285  
 20 Leu Leu Lys Leu Leu Leu Asn Arg Glu Asp Asp Lys Ser Lys Pro Met  
 290 295 300  
 Thr Lys Gln Glu Val Ile Glu Asn Cys Phe Ala Phe Leu Leu Ala Gly  
 305 310 315 320  
 Tyr Glu Thr Thr Ser Thr Ala Met Thr Tyr Cys Ser Tyr Leu Leu Ser  
 25 325 330 335  
 Lys Tyr Pro Asn Val Gln Gln Lys Leu Tyr Glu Glu Ile Met Glu Ala  
 340 345 350  
 Lys Glu Asn Gly Gly Leu Thr Tyr Asp Ser Ile His Asn Met Lys Tyr  
 355 360 365  
 30 Leu Asp Cys Val Tyr Lys Glu Thr Leu Arg Phe Tyr Pro Pro His Phe  
 370 375 380  
 Ser Phe Ile Arg Arg Leu Cys Arg Glu Asp Ile Thr Ile Arg Gly Gln  
 385 390 395 400  
 Phe Tyr Pro Lys Gly Ala Ile Val Val Cys Leu Pro His Thr Val His  
 35 405 410 415  
 Arg Asn Pro Glu Asn Trp Asp Ser Pro Glu Glu Phe His Pro Glu Arg  
 420 425 430  
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 435 440 445  
 40 Gly Val Gly Pro Arg Tyr Cys Val Gly Met Arg Phe Ala Glu Met Glu  
 450 455 460  
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 465 470 475 480  
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 Leu Met Ser Asp Asp Gly Asp Ile Thr Ala Val Ser Ser Gly Asn Arg  
 35 40 45  
 5 Asp Ile Ala Gln Val Val Thr Glu Asn Asn Lys Asn Tyr Leu Val Leu  
 50 55 60  
 Tyr Ala Ser Gln Thr Gly Thr Ala Glu Asp Tyr Ala Lys Lys Phe Ser  
 65 70 75 80  
 Lys Glu Leu Val Ala Lys Phe Asn Leu Asn Val Met Cys Ala Asp Val  
 85 90 95  
 10 Glu Asn Tyr Asp Phe Glu Ser Leu Asn Asp Val Pro Val Ile Val Ser  
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 Ile Phe Ile Ser Thr Tyr Gly Glu Gly Asp Phe Pro Asp Gly Ala Val  
 115 120 125  
 15 Asn Phe Glu Asp Phe Ile Cys Asn Ala Glu Ala Gly Ala Leu Ser Asn  
 130 135 140  
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 145 150 155 160  
 Asn Gly Ala Ala Lys Lys Ala Glu Lys His Leu Ser Ala Ala Gly Ala  
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 20 Ile Arg Leu Gly Lys Leu Gly Glu Ala Asp Asp Gly Ala Gly Thr Thr  
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 Asp Glu Asp Tyr Met Ala Trp Lys Asp Ser Ile Leu Glu Val Leu Lys  
 195 200 205  
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 Gln Tyr Thr Val Leu Asn Glu Ile Thr Asp Ser Met Ser Leu Gly Glu  
 225 230 235 240  
 Pro Ser Ala His Tyr Leu Pro Ser His Gln Leu Asn Arg Asn Ala Asp  
 245 250 255  
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 260 265 270  
 Ile Val Lys Ser Arg Glu Leu Phe Ser Ser Asn Asp Arg Asn Cys Ile  
 275 280 285  
 35 His Ser Glu Phe Asp Leu Ser Gly Ser Asn Ile Lys Tyr Ser Thr Gly  
 290 295 300  
 Asp His Leu Ala Val Trp Pro Ser Asn Pro Leu Glu Lys Val Glu Gln  
 305 310 315 320  
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 325 330 335  
 40 Pro Leu Asp Pro Thr Val Lys Val Pro Phe Pro Thr Pro Thr Thr Ile  
 340 345 350  
 Gly Ala Ala Ile Lys His Tyr Leu Glu Ile Thr Gly Pro Val Ser Arg  
 355 360 365  
 45 Gln Leu Phe Ser Ser Leu Ile Gln Phe Ala Pro Asn Ala Asp Val Lys  
 370 375 380  
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 385 390 395 400  
 Ile Thr Ser Lys Tyr Phe Asn Ile Ala Asp Ala Leu Lys Tyr Leu Ser  
 405 410 415  
 50 Asp Gly Ala Lys Trp Asp Asn Val Pro Met Gln Phe Leu Val Glu Ser  
 420 425 430  
 Val Pro Gln Met Thr Pro Arg Tyr Tyr Ser Ile Ser Ser Ser Ser Leu  
 435 440 445  
 Ser Glu Lys Gln Thr Val His Val Thr Ser Ile Val Glu Asn Phe Pro  
 450 455 460  
 55 Asn Pro Glu Leu Pro Asp Ala Pro Pro Gly Val Gly Val Thr Thr Asn  
 465 470 475 480

Leu Leu Arg Asn Ile Gln Leu Ala Gln Asn Asn Val Asn Ile Ala Glu  
 485 490 495  
 Thr Asn Leu Pro Val His Tyr Asp Leu Asn Gly Pro Arg Lys Leu Phe  
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 5 Ala Asn Tyr Lys Leu Pro Val His Val Arg Arg Ser Asn Phe Arg Leu  
 515 520 525  
 Pro Ser Asn Pro Ser Thr Pro Val Ile Met Ile Gly Pro Gly Thr Gly  
 530 535 540  
 Val Ala Pro Phe Arg Gly Phe Ile Arg Glu Arg Val Ala Phe Leu Glu  
 545 550 555 560  
 10 Ser Gln Lys Lys Gly Gly Asn Asn Val Ser Leu Gly Lys His Ile Leu  
 565 570 575  
 Phe Tyr Gly Ser Arg Asn Thr Asp Asp Phe Leu Tyr Gln Asp Glu Trp  
 580 585 590  
 15 Pro Glu Tyr Ala Lys Lys Leu Asp Gly Ser Phe Glu Met Val Val Ala  
 595 600 605  
 His Ser Arg Leu Pro Asn Thr Lys Lys Val Tyr Val Gln Asp Lys Leu  
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 Lys Asp Tyr Glu Asp Gln Val Phe Glu Met Ile Asn Asn Gly Ala Phe  
 625 630 635 640  
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 Ala Leu Val Gly Ile Leu Ser Arg Gly Lys Ser Ile Thr Thr Asp Glu  
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 35 40 45  
 Ala Gly Lys Thr Arg Asn Ile Ile Glu Lys Met Glu Glu Thr Gly Lys  
 50 55 60  
 Asn Cys Val Ile Phe Tyr Gly Ser Gln Thr Gly Thr Ala Glu Asp Tyr  
 65 70 75 80  
 45 Ala Ser Arg Leu Ala Lys Glu Gly Ser Gln Arg Phe Gly Leu Lys Thr  
 85 90 95  
 Met Val Ala Asp Leu Glu Glu Tyr Asp Tyr Glu Asn Leu Asp Gln Phe  
 100 105 110  
 50 Pro Glu Asp Lys Val Ala Phe Phe Val Leu Ala Thr Tyr Gly Glu Gly  
 115 120 125  
 Glu Pro Thr Asp Asn Ala Val Glu Phe Tyr Gln Phe Phe Thr Gly Asp  
 130 135 140  
 Asp Val Ala Phe Glu Ser Ala Ser Ala Asp Glu Lys Pro Leu Ser Lys  
 145 150 155 160  
 55 Leu Lys Tyr Val Ala Phe Gly Leu Gly Asn Asn Thr Tyr Glu His Tyr  
 165 170 175

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100



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[illegible]



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	Pro Thr Asn Ala Gly Ala Glu Val Asp Arg Phe Leu Gln Val Phe Gly						
		325		330		335	
40	Leu Glu Gly Lys Arg Asp Ser Val Ile Asn Ile Lys Gly Ile Asp Val						
	340		345		350		
	Thr Ala Lys Val Pro Ile Pro Thr Pro Thr Thr Tyr Asp Ala Ala Val						
	355		360		365		
	Arg Tyr Tyr Met Glu Val Cys Ala Pro Val Ser Arg Gln Phe Val Ala						
45	370		375		380		
	Thr Leu Ala Ala Phe Ala Pro Met Arg Lys Ala Arg Gln Arg Leu Cys						
	385		390		395		400
	Val Trp Val Ala Gln Gly Leu Phe Pro Arg Glu Gly His Gln Pro Met						
		405		410		415	
50	Leu Gln His Ala Gln Ala Leu Gln Ser Ile Thr Ser Lys Pro Phe Ser						
	420		425		430		
	Ala Val Pro Phe Ser Leu Leu Ile Glu Gly Ile Thr Lys Leu Gln Pro						
	435		440		445		
	Arg Tyr Tyr Ser Ile Ser Ser Ser Ser Leu Val Gln Lys Asp Lys Ile						
55	450		455		460		
	Ser Ile Thr Ala Val Val Glu Ser Val Arg Leu Pro Gly Ala Ser His						
	465		470		475		480

Met Val Lys Gly Val Thr Thr Asn Tyr Leu Leu Ala Leu Lys Gln Lys  
 485 490 495  
 Gln Asn Gly Arg Ser Leu Ser Arg Pro Ser Arg Leu Asp Leu Leu His  
 500 505 510  
 5 His Gly Pro Arg Asn Lys Tyr Asp Gly Ile His Val Pro Val His Val  
 515 520 525  
 Arg His Ser Asn Phe Lys Leu Pro Ser Asp Pro Ser Arg Pro Ile Ile  
 530 535 540  
 10 Met Val Gly Pro Gly Thr Gly Val Ala Pro Phe Arg Gly Phe Ile Gln  
 545 550 555 560  
 Glu Arg Ala Ala Leu Ala Ala Lys Gly Glu Lys Val Gly Pro Thr Val  
 565 570 575  
 Leu Phe Phe Gly Cys Arg Lys Ser Asp Glu Asp Phe Leu Tyr Lys Asp  
 580 585 590  
 15 Glu Trp Lys Thr Tyr Gln Asp Gln Leu Gly Asp Asn Leu Lys Ile Ile  
 595 600 605  
 Thr Ala Phe Ser Arg Glu Gly Pro Gln Lys Val Tyr Val Gln His Arg  
 610 615 620  
 Leu Arg Glu His Ser Glu Leu Val Ser Asp Leu Leu Lys Gln Lys Ala  
 625 630 635 640  
 20 Thr Phe Tyr Val Cys Gly Asp Ala Ala Asn Met Ala Arg Glu Val Asn  
 645 650 655  
 Leu Val Leu Gly Gln Ile Ile Ala Ala Gln Arg Gly Leu Pro Ala Glu  
 660 665 670  
 25 Lys Gly Glu Glu Met Val Lys His Met Arg Arg Arg Gly Arg Tyr Gln  
 675 680 685  
 Glu Asp Val Trp Ser  
 690

**ASPERGILLUS OCHRACEUS 11 ALPHA HYDROXYLASE AND OXIDOREDUCTASE..... 1**

	PRIORITY.....	1
	FIELD OF THE INVENTION.....	1
	BACKGROUND OF THE INVENTION.....	1
5	SUMMARY OF THE INVENTION.....	5
	DEFINITIONS.....	16
	<i>Figure 1 - Nucleotide and protein sequence of Aspergillus ochraceus 11 alpha hydroxylase ..</i>	23
	<i>Figure 2 - Nucleotide and protein sequence of human oxidoreductase.....</i>	23
	<i>Figure 3 - Nucleotide and protein sequence of Aspergillus ochraceus oxidoreductase .....</i>	24
10	<i>Figure 4 - Amino acid homology alignment of A. ochraceus 11 alpha hydroxylase with the top 10 BLAST hits from GenBank.....</i>	24
	<i>Figure 5 - Phylogenetic tree showing the relatedness of Aspergillus ochraceus 11 alpha hydroxylase to the top 10 BLAST hits from GenBank.....</i>	25
15	<i>Figure 6 - Percent homology between Aspergillus ochraceus 11 alpha hydroxylase and the top 10 BLAST hits from GenBank.....</i>	26
	<i>Figure 7 - Amino acid homology alignment of Aspergillus ochraceus and human oxidoreductase to NADPH cytochrome P450 reductases from A. niger, mouse, and S. cerevisiae.....</i>	26
20	<i>Figure 8 - Amino acid homology alignment of A. ochraceus oxidoreductase to NADPH cytochrome P450 reductases from A. niger, mouse, and S. cerevisiae.....</i>	27
	<i>Figure 9 - Phylogenetic tree showing the relatedness of Aspergillus ochraceus and human oxidoreductase to reductases from A. niger, yeast, and mouse. ....</i>	27
	<i>Figure 10 - Percent identity between Aspergillus ochraceus oxidoreductase and reductases from A. niger, yeast, and mouse.....</i>	27
25	<i>Figure 11 - Alignment of human oxidoreductase with top 4 hits from SwissProt.....</i>	27
	<i>Figure 12 - Phylogenetic tree showing the relatedness of human oxidoreductases with top 4 hits from SwissProt.....</i>	28
	<i>Figure 13 - Percent identity between human oxidoreductase and top 4 hits from SwissProt... ..</i>	28
30	<i>Figure 14: Expression of Aspergillus ochraceus 11 alpha hydroxylase in transfected Sf9 insect cells.....</i>	29
	<i>Figure 15: Expression of Aspergillus ochraceus P450 oxidoreductase in transfected Sf9 insect cells.....</i>	29
	<i>Figure 16 - Conversion of androstenedione to 11 alpha hydroxy androstenedione monitored by HPLC.....</i>	29
35	DETAILED DESCRIPTION OF THE INVENTION.....	30
	Cloning techniques.....	33
	Hybridization.....	34
	Expression vectors.....	35
	Yeast.....	36
40	Mammalian.....	36
	Transformation and transfection.....	38
	Insect Cell Expression.....	39
	Materials and Methods.....	41
	General methods.....	41
45	Strains, plasmids, and sequence cross listings.....	41
	Table 1: Strains .....	42
	Table 2: Plasmids .....	43
	Table 3: Table of Sequences .....	45
	Specific Methods.....	47
50	Transformation of E. coli strains.....	47
	DNA isolation and characterization .....	48
	DNA Sequencing protocols.....	48
	BLAST, ClustalW, and Boxshade homology alignment tools .....	50
	Protein Purification and Characterization.....	51
55	EXAMPLES.....	52
	<i>Example 1 - Preparation of A. ochraceus spores for RNA extraction .....</i>	52
	<i>Example 2 - A. ochraceus spores catalyze 11 <math>\alpha</math>-hydroxylation of canrenone .....</i>	53
	<i>Example 3 - Growth of A. ochraceus Mycelia for RNA extraction.....</i>	53
	<i>Example 4 - Extraction of total RNA from induced spores.....</i>	53

	<u>Example 5 - Extraction of total RNA from induced mycelia.....</u>	<u>54</u>
	<u>Example 6 - Extraction of Total RNA from HepG2 cells.....</u>	<u>54</u>
	<u>Example 7 - PolyA<sup>+</sup> Selection of mRNA.....</u>	<u>55</u>
	<u>Example 8 - cDNA Synthesis and Library Construction.....</u>	<u>55</u>
5	<u>Example 9 - Size Fractionation of cDNA.....</u>	<u>56</u>
	<u>Example 10 - Library Construction in Vector pSport1 and Electroporation into E. coli.....</u>	<u>56</u>
	<u>Example 11 - Identification of clones encoding cytochrome P450 enzymes by DNA</u>	
	<u>sequence analysis and construction of plasmid pMON45624 encoding Aspergillus</u>	
	<u>ochraceus 11 alpha hydroxylase.....</u>	<u>57</u>
10	<u>Cloning of 11 alpha hydroxylase from Aspergillus ochraceus .....</u>	<u>57</u>
	<u>Gene Amplification of Aspergillus ochraceus 11 alpha hydroxylase .....</u>	<u>57</u>
	<u>Construction of pMON45624.....</u>	<u>58</u>
	<u>Example 12 - Amplification of cDNA encoding human NADPH Cytochrome P450</u>	
	<u>reductase and cloning into plasmids pMON45603, pMON45604, and pMON45605 .....</u>	<u>58</u>
15	<u>Gene Amplification of human oxidoreductase .....</u>	<u>58</u>
	<u>Construction of pMON45603, pMON45604, pMON45605 .....</u>	<u>59</u>
	<u>Example 13 - Amplification of cDNA encoding NADPH cytochrome P450 reductase from</u>	
	<u>A. ochraceus and cloning into plasmids pMON45630, pMON45631, and pMON45632.....</u>	<u>60</u>
	<u>Gene Amplification of Aspergillus ochraceus oxidoreductase.....</u>	<u>60</u>
20	<u>Construction of pMON45630.....</u>	<u>62</u>
	<u>Construction of pMON45631 and pMON45632.....</u>	<u>62</u>
	<u>Example 15: Generation of polyclonal antibodies recognizing Aspergillus ochraceus 11</u>	
	<u>alpha hydroxylase and Aspergillus ochraceus NADPH cytochrome p450 reductase .....</u>	<u>63</u>
	<u>Generation of anti-11-a-hydroxylase Antibodies.....</u>	<u>63</u>
25	<u>Example 16 - Insect Cell Infection and Heterologous Expression.....</u>	<u>64</u>
	<u>Example 17: Co-infection baculoviruses expressing of Aspergillus ochraceus 11 alpha</u>	
	<u>hydroxylase and human oxidoreductase.....</u>	<u>65</u>
	<u>Example 18: Co-infection baculoviruses expressing of Aspergillus ochraceus 11 alpha</u>	
	<u>hydroxylase and Aspergillus ochraceus oxidoreductase .....</u>	<u>66</u>
30	<u>Example 19: Preparation of subcellular fractions from baculovirus-infected insect cells.....</u>	<u>66</u>
	<u>Microsomal Incubations.....</u>	<u>67</u>
	<u>Example 20: HPLC assays to measure conversion of steroid substrates to their</u>	
	<u>hydroxylated counterparts.....</u>	<u>67</u>
	<u>High Performance Liquid Chromatography (HPLC).....</u>	<u>67</u>
35	<u>Example 21: Recognition of Aspergillus ochraceus 11 alpha hydroxylase and Aspergillus</u>	
	<u>ochraceus NADPH cytochrome p450 reductase by immunoblotting using polyclonal</u>	
	<u>antibodies generated against synthetic peptides.....</u>	<u>69</u>
	<u>Example 22: Characterization of the Aspergillus ochraceus genomic DNA encoding 11</u>	
	<u>alpha hydroxylase and oxidoreductase.....</u>	<u>70</u>
40	<u>REFERENCES .....</u>	<u>72</u>
	<u>CLAIMS.....</u>	<u>83</u>
	<u>ASPERGILLUS OCHRACEUS 11 ALPHA-HYDROXYLASE AND OXIDOREDUCTASE ..</u>	<u>95</u>
	<u>ABSTRACT.....</u>	<u>95</u>
	<u>FIGURES.....</u>	<u>1</u>
45	<u>FIGURE 1 - NUCLEOTIDE AND PROTEIN SEQUENCE OF ASPERGILLUS OCHRACEUS 11 ALPHA</u>	
	<u>HYDROXYLASE .....</u>	<u>1</u>
	<u>FIGURE 2 - NUCLEOTIDE AND PROTEIN SEQUENCE OF HUMAN OXIDOREDUCTASE .....</u>	<u>3</u>
	<u>FIGURE 3 - NUCLEOTIDE AND PROTEIN SEQUENCE OF ASPERGILLUS OCHRACEUS</u>	
	<u>OXIDOREDUCTASE.....</u>	<u>6</u>
50	<u>FIGURE 4 - AMINO ACID HOMOLOGY ALIGNMENT OF A. OCHRACEUS 11 ALPHA HYDROXYLASE</u>	
	<u>WITH THE TOP 10 BLAST HITS FROM GENBANK .....</u>	<u>9</u>
	<u>FIGURE 5 - PHYLOGENETIC TREE SHOWING THE RELATEDNESS OF ASPERGILLUS OCHRACEUS 11</u>	
	<u>ALPHA HYDROXYLASE TO THE TOP 10 BLAST HITS FROM GENBANK.....</u>	<u>11</u>
	<u>FIGURE 6 - PERCENT HOMOLOGY OF ASPERGILLUS OCHRACEUS 11 ALPHA HYDROXYLASE TO</u>	
55	<u>THE TOP 10 BLAST HITS FROM GENBANK .....</u>	<u>12</u>
	<u>FIGURE 7 - AMINO ACID HOMOLOGY ALIGNMENT OF A. OCHRACEUS AND HUMAN</u>	
	<u>OXIDOREDUCTASE TO NADPH CYTOCHROME P450 REDUCTASES FROM A. NIGER, MOUSE, AND</u>	
	<u>S. CEREVISIAE .....</u>	<u>13</u>

	<u>FIGURE 8 – AMINO ACID HOMOLGY ALIGNMENT OF A. OCHRACEUS OXIDOREDUCTASE TO NADPH CYTOCHROME P450 REDUCTASES FROM A. NIGER AND S. CEREVISIAE .....</u>	<u>15</u>
	<u>FIGURE 9 – PHYLOGENETIC TREE SHOWING THE RELATEDNESS OF ASPERGILLUS OCHRACEUS AND HUMAN OXIDOREDUCTASE TO REDUCTASES FROM A. NIGER, YEAST, AND MOUSE. ....</u>	<u>16</u>
5	<u>FIGURE 10 – PERCENT HOMOLGY BETWEEN ASPERGILLUS OCHRACEUS OXIDOREDUCTASE TO REDUCTASES FROM A. NIGER, YEAST, AND MOUSE AND HUMAN. ....</u>	<u>17</u>
	<u>FIGURE 11 – AMINO ACID HOMOLGY ALIGNMENT OF HUMAN OXIDOREDUCTASE WITH THE TOP 4 HITS FROM SWISSPROT .....</u>	<u>18</u>
10	<u>FIGURE 12 – PHYLOGENETIC TREE SHOWING THE RELATEDNESS OF HUMAN OXIDOREDUCTASE (P16435) WITH TOP 4 HITS FROM SWISSPROT .....</u>	<u>21</u>
	<u>FIGURE 13 – PERCENT HOMOLGY BETWEEN HUMAN OXIDOREDUCTASE AND TOP 4 HITS FROM SWISSPROT .....</u>	<u>22</u>
	<u>FIGURE 14 - EXPRESSION OF ASPERGILLUS OCHRACEUS 11 ALPHA HYDROXYLASE IN TRANSFECTED Sf9 INSECT CELLS .....</u>	<u>23</u>
15	<u>FIGURE 15 - EXPRESSION OF ASPERGILLUS OCHRACEUS P450 OXIDOREDUCTASE IN TRANSFECTED Sf9 INSECT CELLS .....</u>	<u>24</u>
	<u>FIGURE 16 - CONVERSION OF ANDROSTENEDIONE TO 11 ALPHA HYDROXY ANDROSTENEDIONE MONITORED BY HPLC.....</u>	<u>25</u>
20	<u>SEQUENCE LISTING .....</u>	<u>1</u>